Submarine Sediment Distribution Patterns within the Bengal Fan System, Deep Water Bengal Basin, India*

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Search and Discovery Article #50756 (2012)**
Posted November 30, 2012

*Adapted from oral presentation at AAPG International Convention and Exhibition, Singapore, 16-19 September 2012

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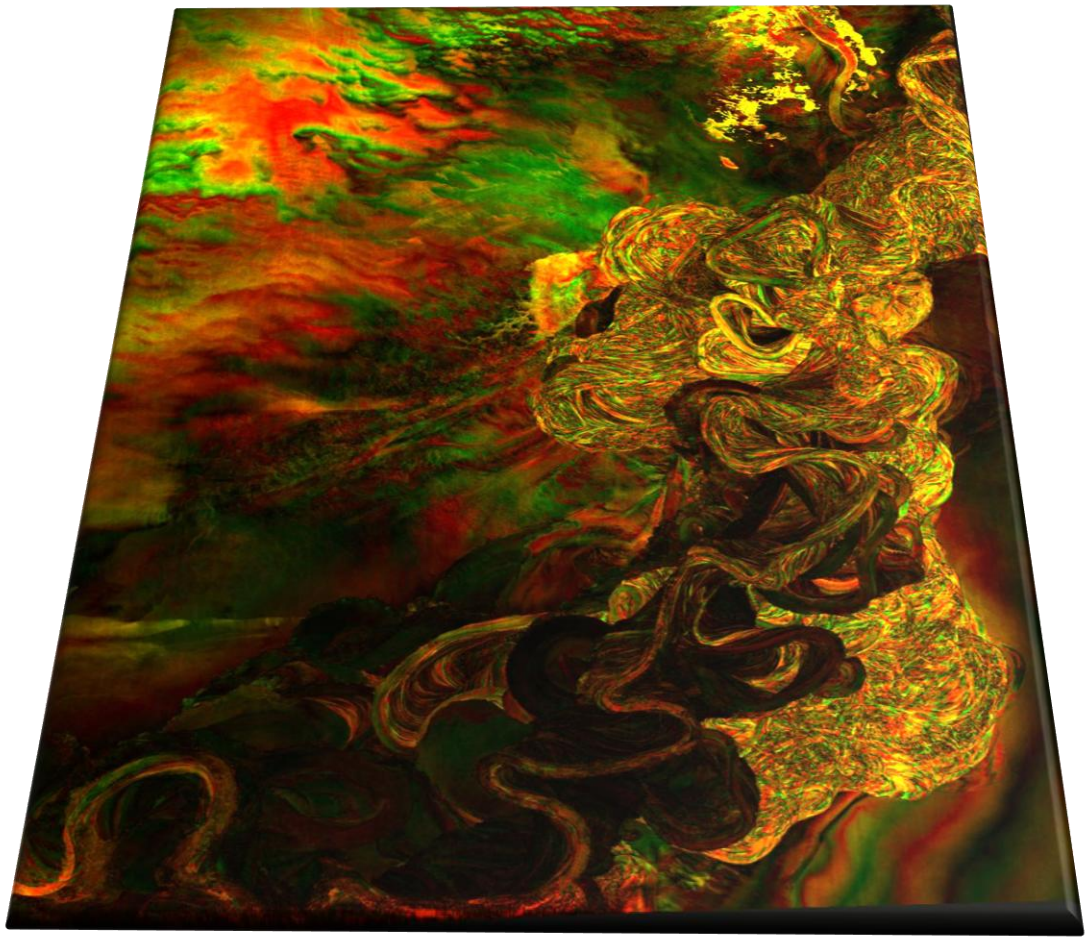
Abstract

The Bay of Bengal is home to the world's largest submarine fan. This system has developed since the Eocene predominantly in response to the Himalayan orogeny. A third of the sediments discharged annually by the Ganges-Brahmaputra river system are reportedly making their way into the deepwater at present day. Sediment supply to the fan is primarily controlled by the Swatch of No Ground, a prominent 15 km wide Pleistocene canyon connecting the shallow shelf and Ganges-Brahmaputra delta to the deepwater.

Santos proprietary seismic dataset in the northern Bay of Bengal covers over 16,000 km^2 of the continental slope-upper fan transition. A circa 3,500 km^2 3D survey acquired in addition to the 2D grid facilitates seismic attribute analysis and further refinement of the depositional model.

Study of the modern-day morphology of the Bengal Fan provides unique insights into resolving past depositional patterns and ultimately increases our understanding of the petroleum prospectivity. The area of interest is characterized by a well defined shelf edge, locally affected by slumping and mass wasting events, but with a notable absence of significant growth faulting frequently present in other large delta systems. The present canyon feeder system cuts erosively through the shelf edge, passing down-slope into depositional channel systems in the proximal part of the fan. The upper fan in dominated by large-scale, sinuous and aggradational Channel Levee Complexes (CLCs). A channel avulsion depositional model appears to fit geometries observed seismically, with basal High Amplitude Reflective Packages (HARPs) units being ultimately overrun by the CLCs. The process is repeated temporally throughout the section at various scales, this being dependent upon sedimentation influx rate and frequency of avulsion. The overall trend shows CLCs decreasing in size with depth, which is in accordance with a progradational model for the Bengal delta/fan system.

Detailed depositional analysis is key to defining sand-prone fairways, potential sealing units and trapping configurations in the system. In the absence of well data, analogy with proven deepwater submarine fans system worldwide is considered essential in evaluating this underexplored basin.



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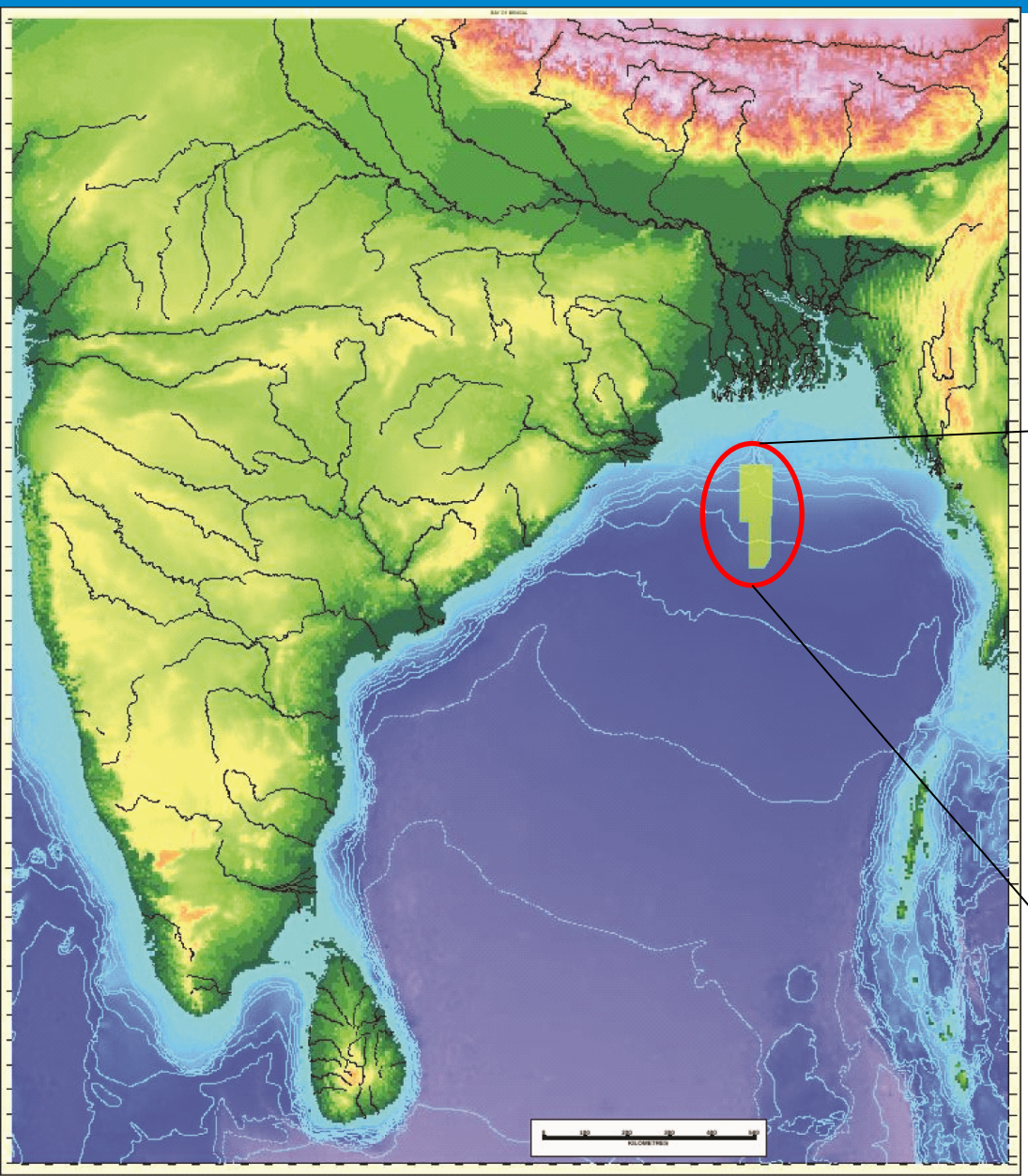
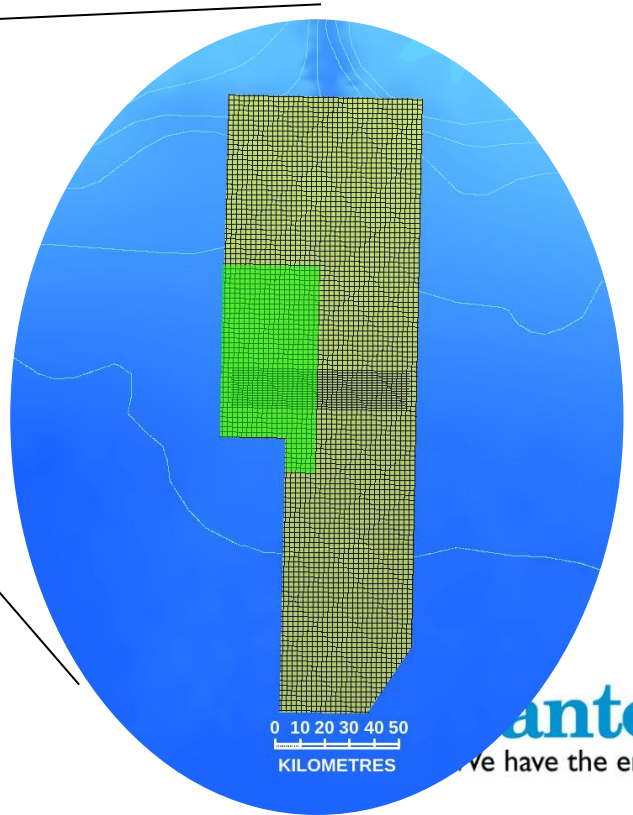
NEC-DWN-2004/1&2

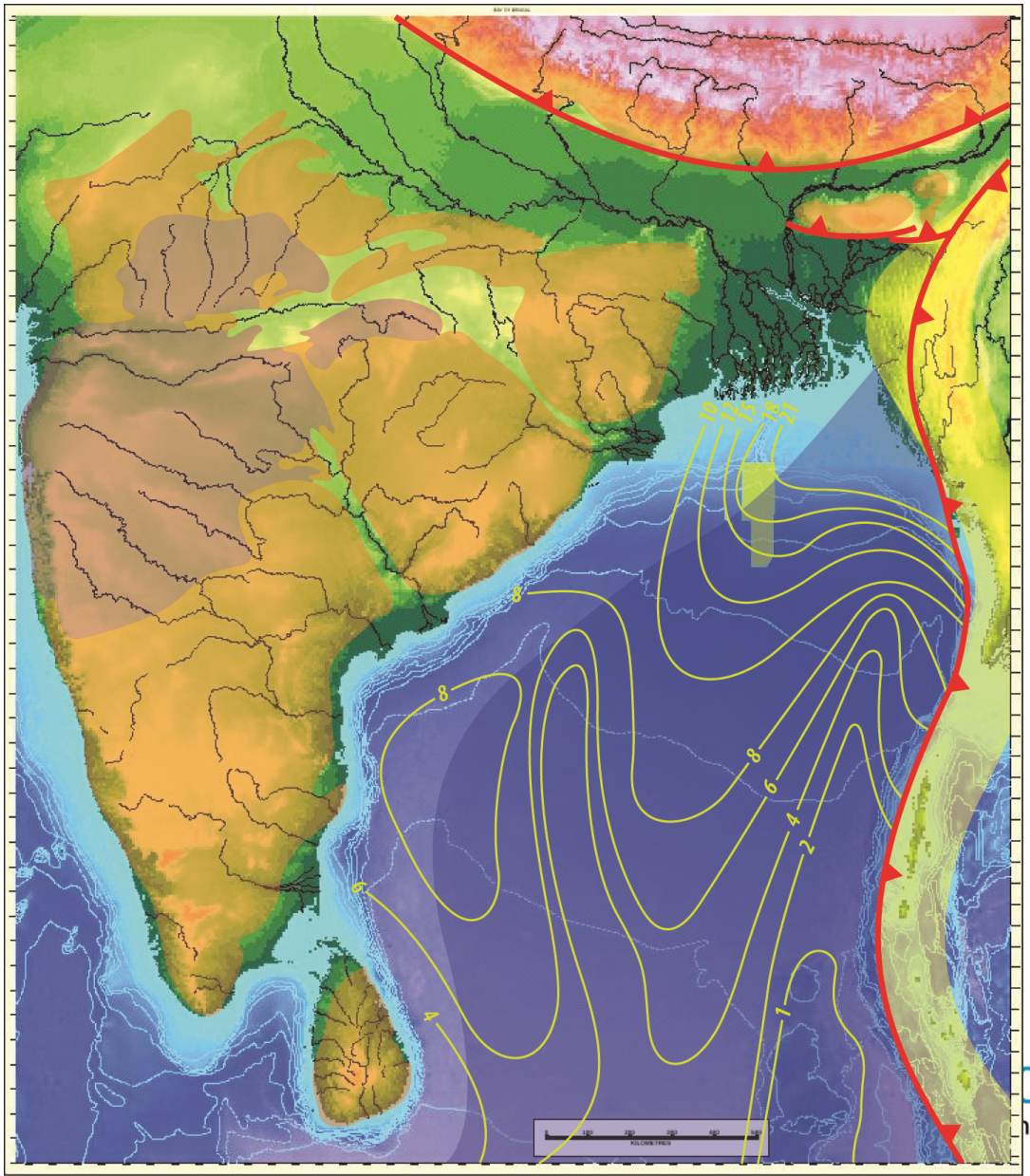


NEC-DWN-2004/1 & 2
Awarded 2007 (NELP VI)
16,500km^2
Water depth 500m – 2300m

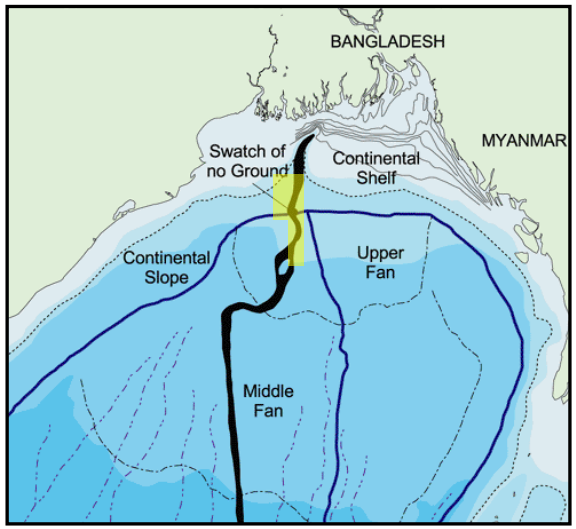
17,500km 2D seismic data acquired in 2008
~4000km^2 3D seismic data acquired in 2009

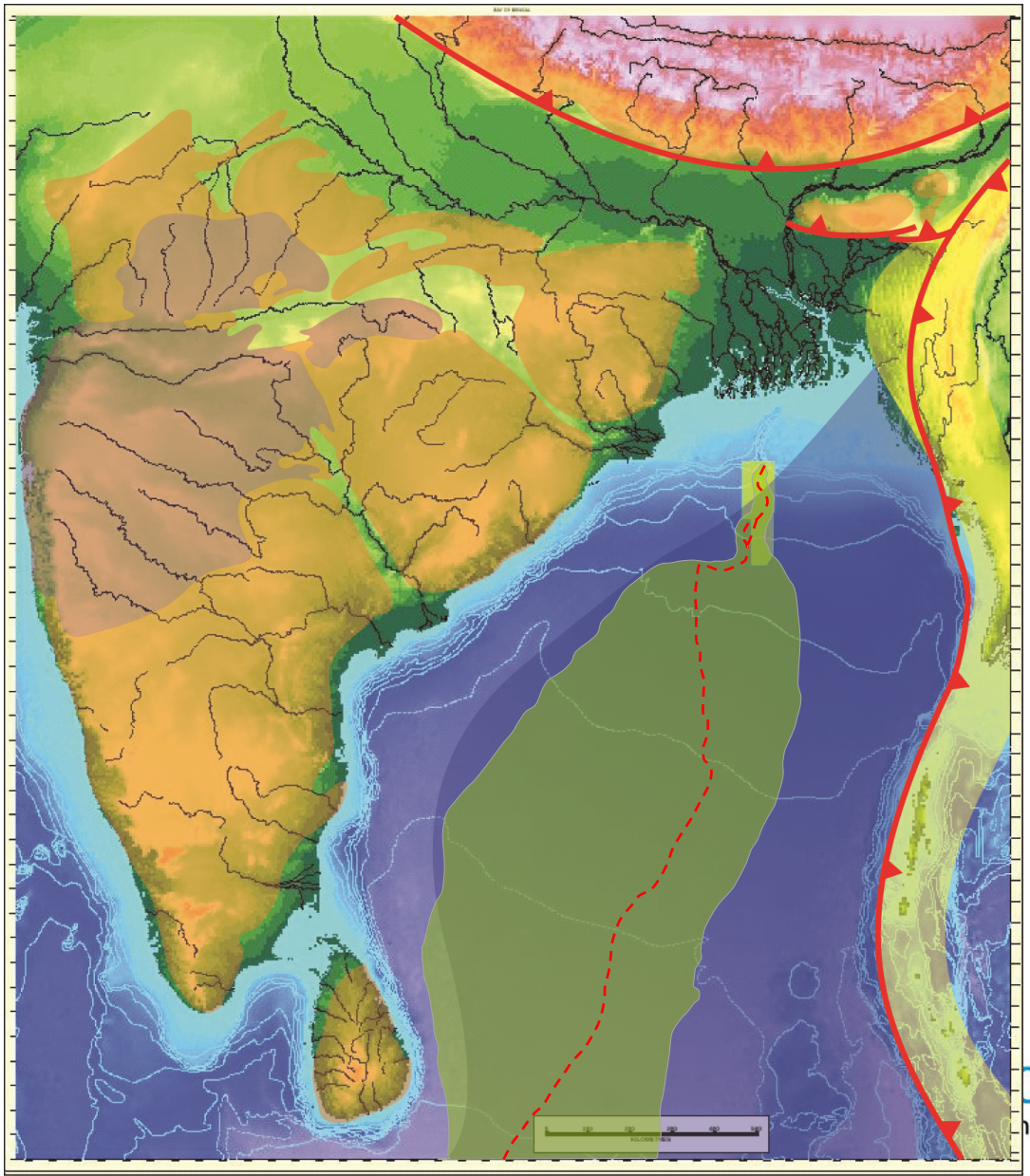


Regional tectonic framework



Regional framework





About 3000km long x 1400km max. width

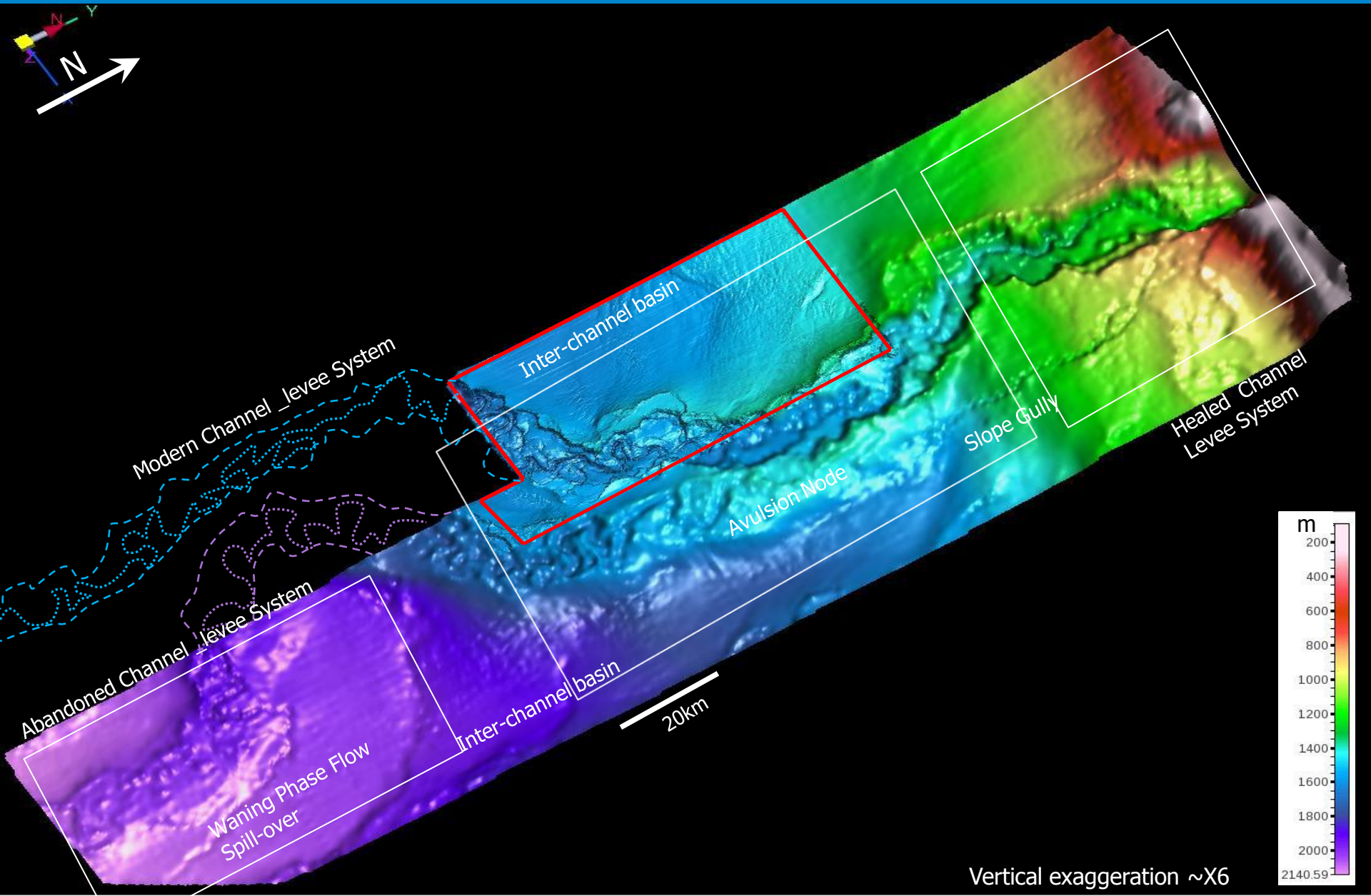
Area ~3 $10^6 km^2$

Fan sediment catchment area: ~ 2 10^6 km^2

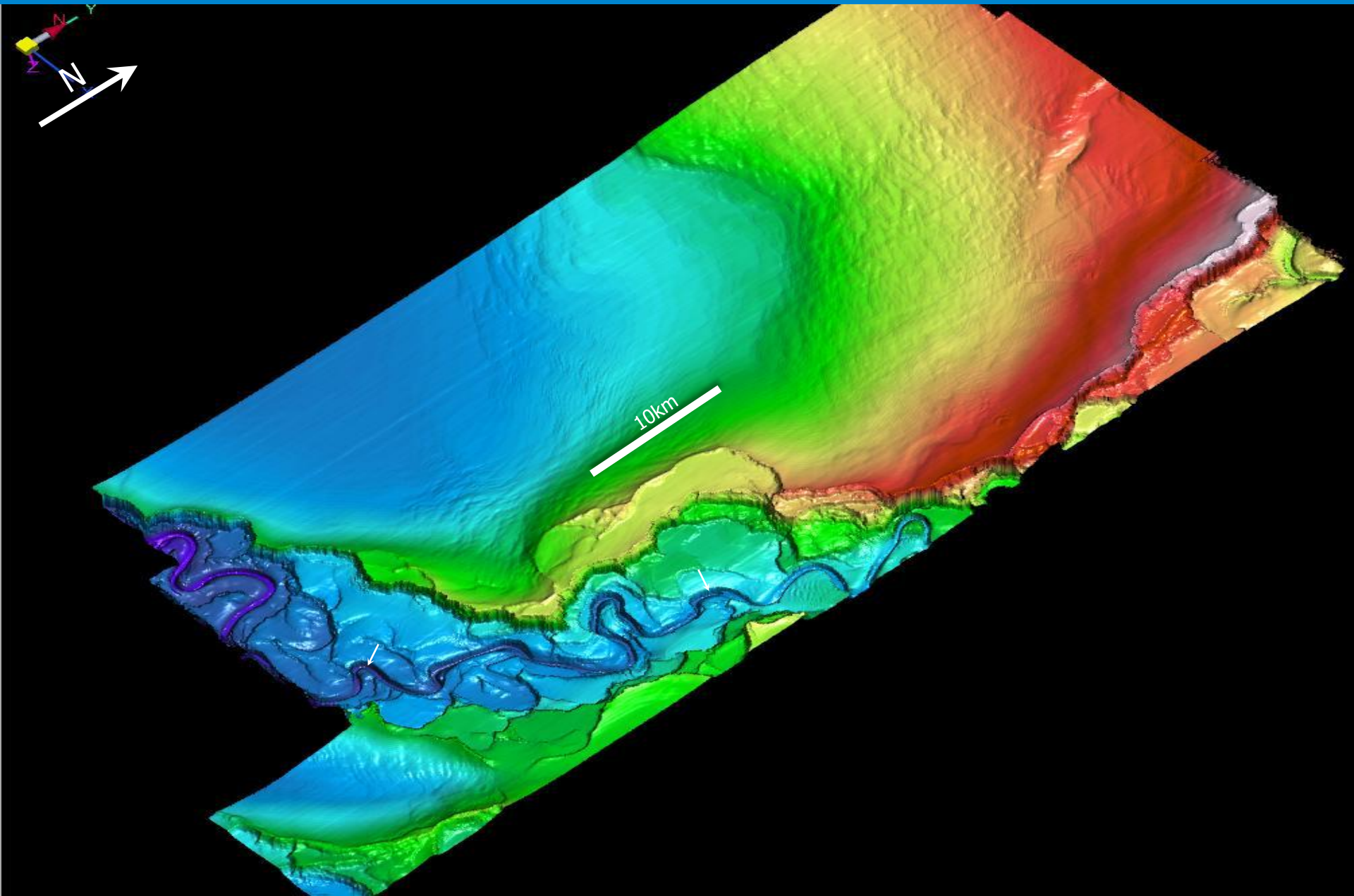
Sediment Load ~ 1 10^9 tonne x 2.5 during Early Holocene

Estimated volume 12.5 $10^6 Km^3$

Bathymetry from seismic data



Bathymetry from 3D seismic data



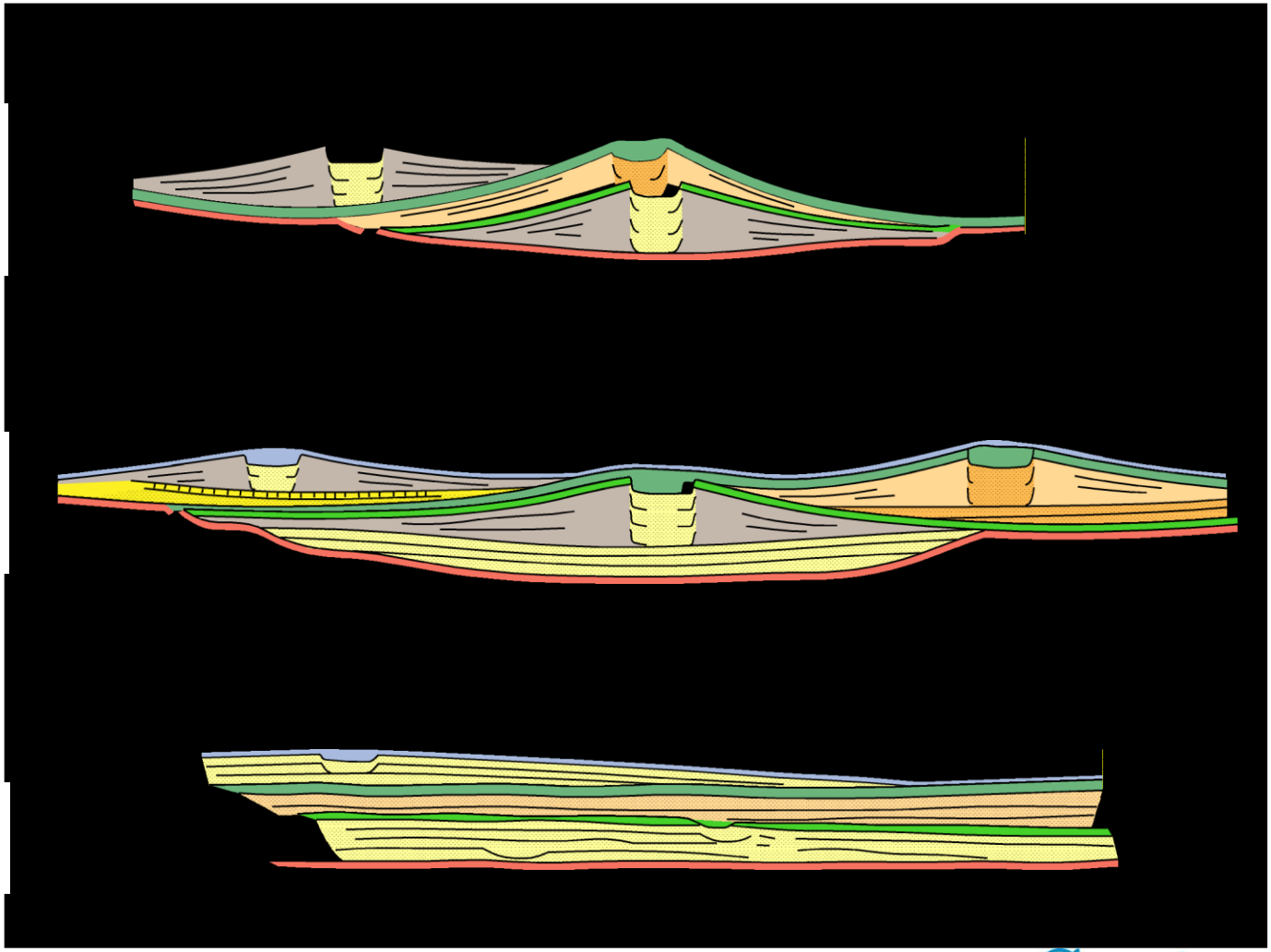
Avulsion model

DOWNSYSTEM

Ponded crevasse splays develop adajacent to the main channel channel segment

Frontal splays develop below main feeder channels at transition points

Terminal lobes form at end of avulsed channel segments



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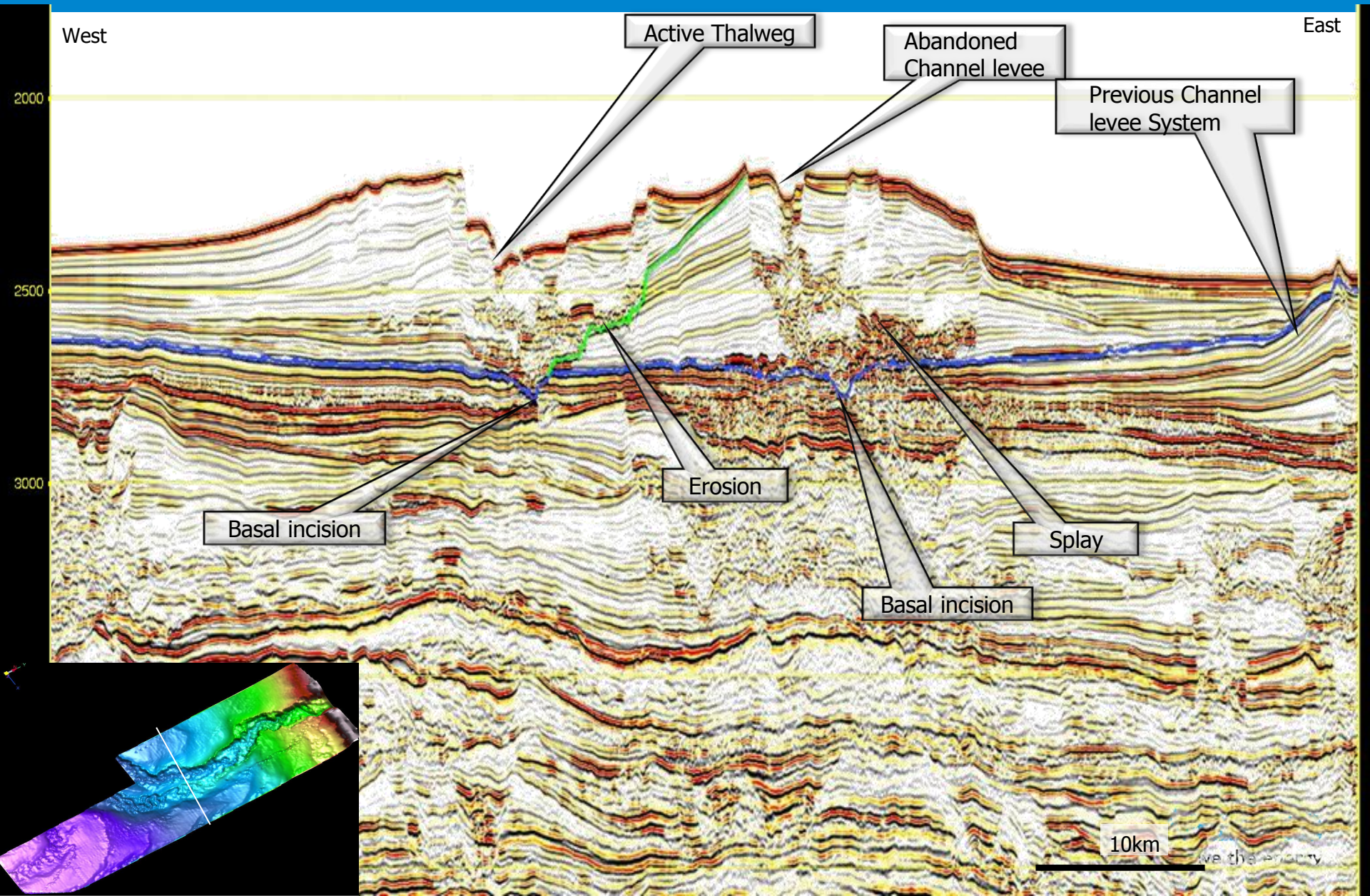
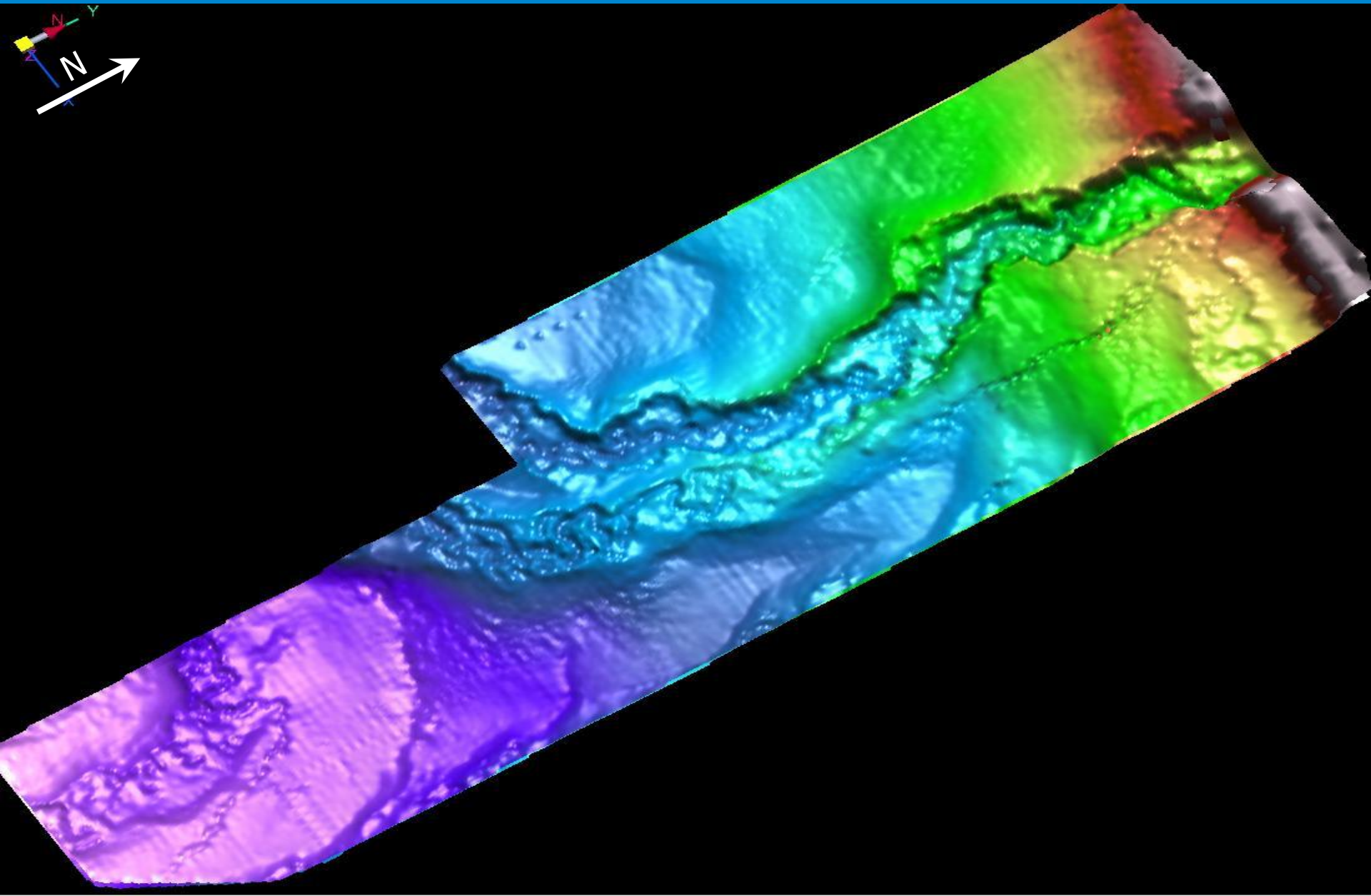
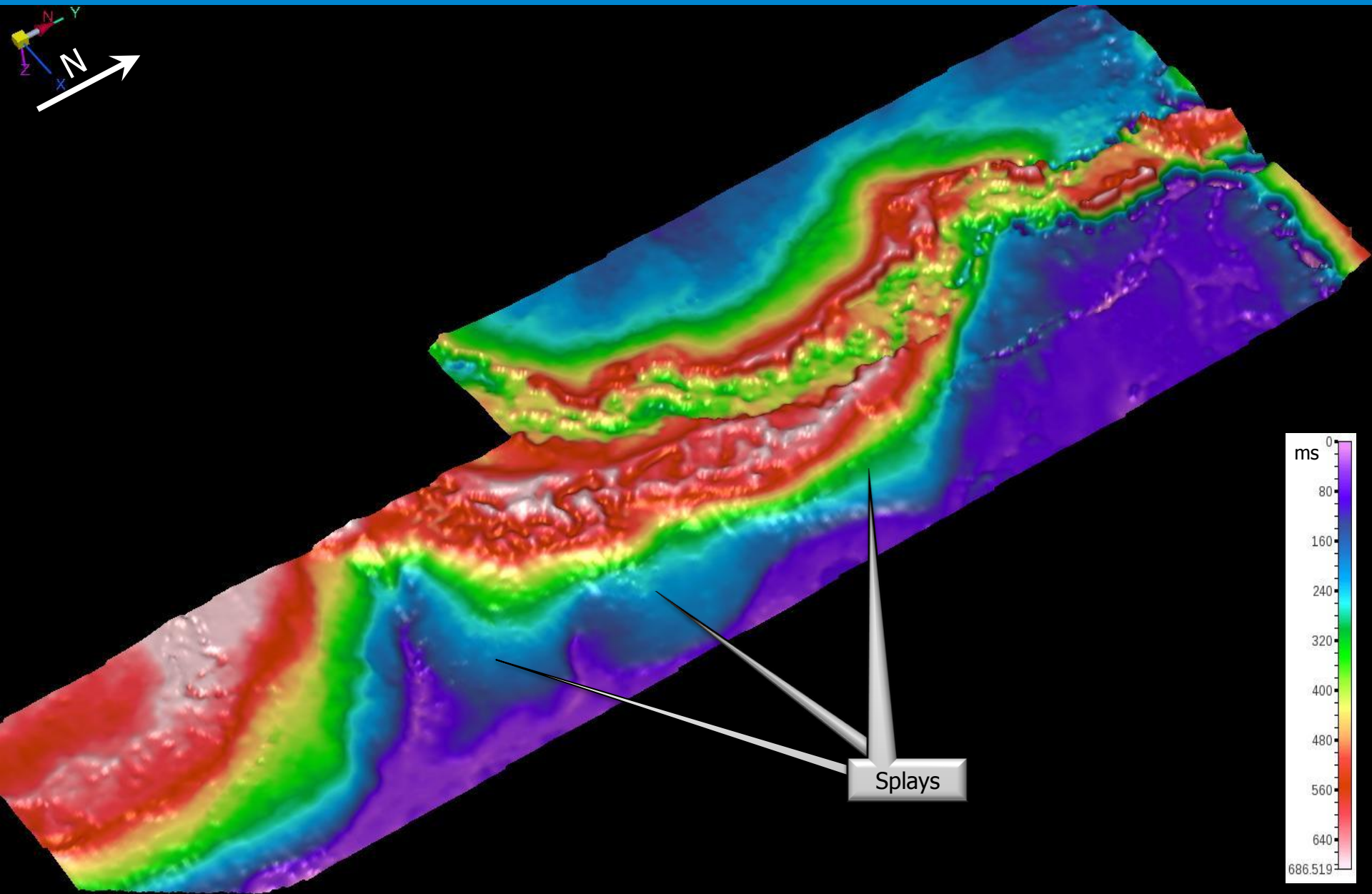
Cross section Channel-levee system



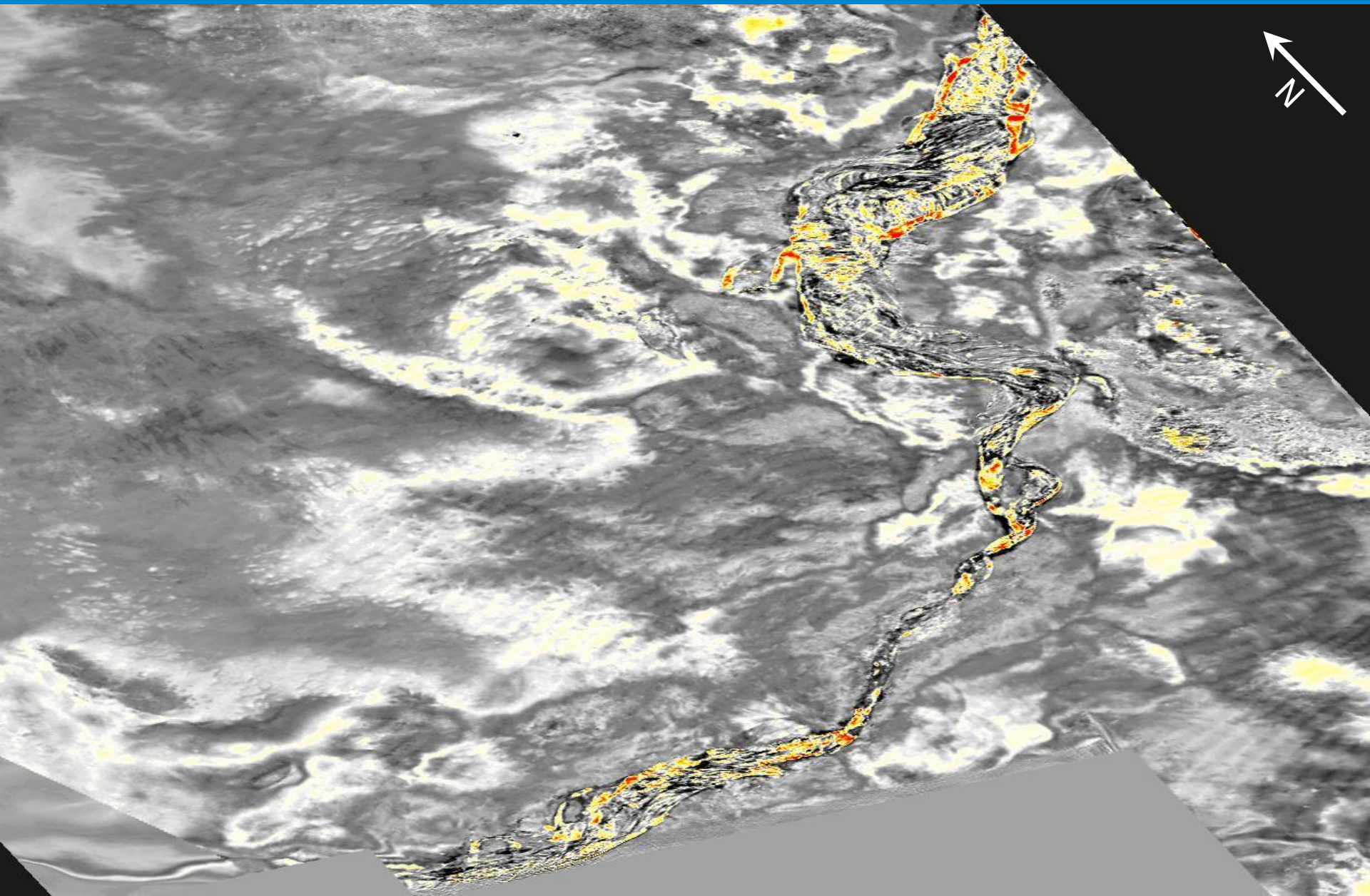
Bathymetry / basal Channel-levee surface



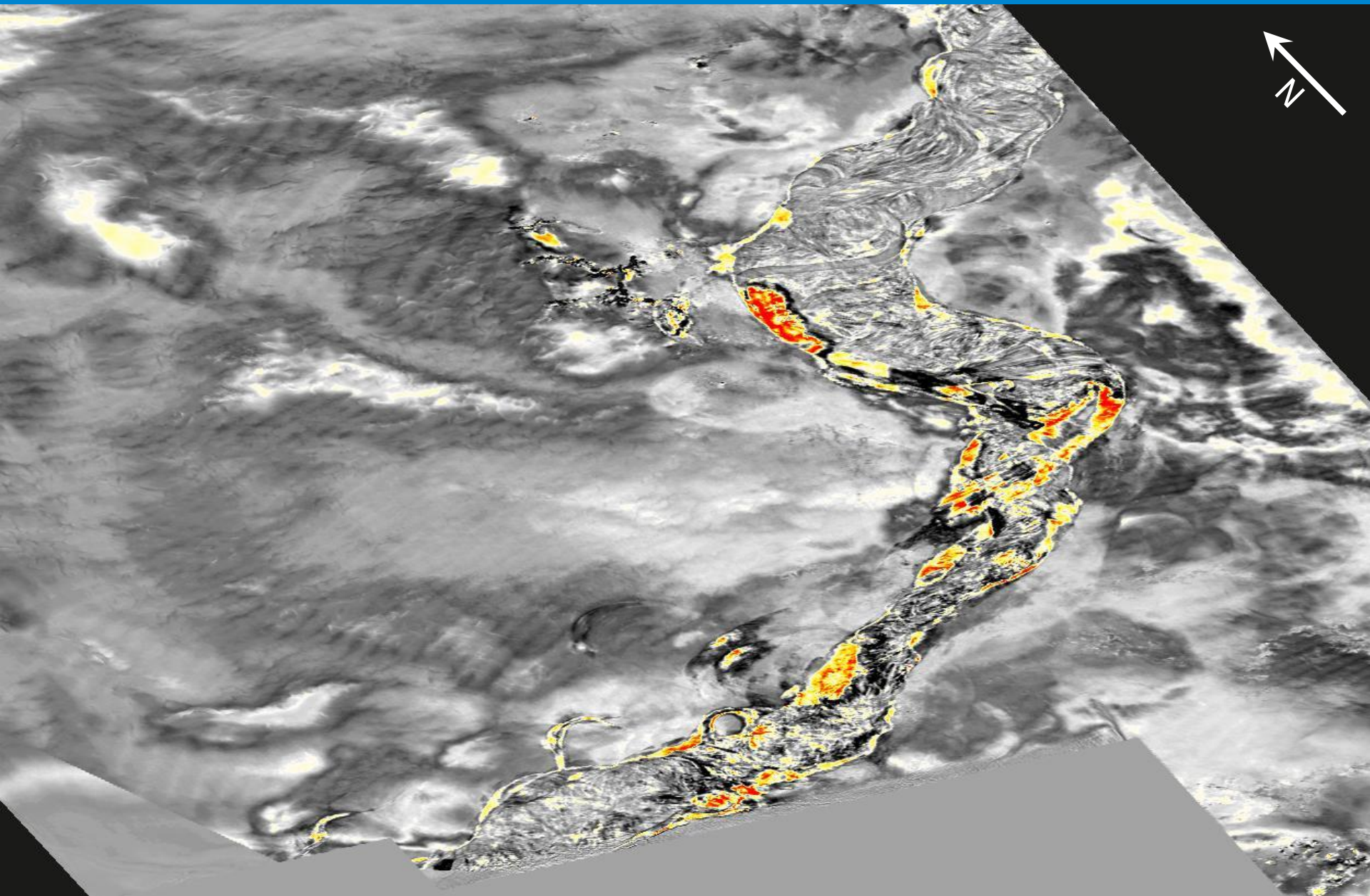
Isochrone current Channel-levee system



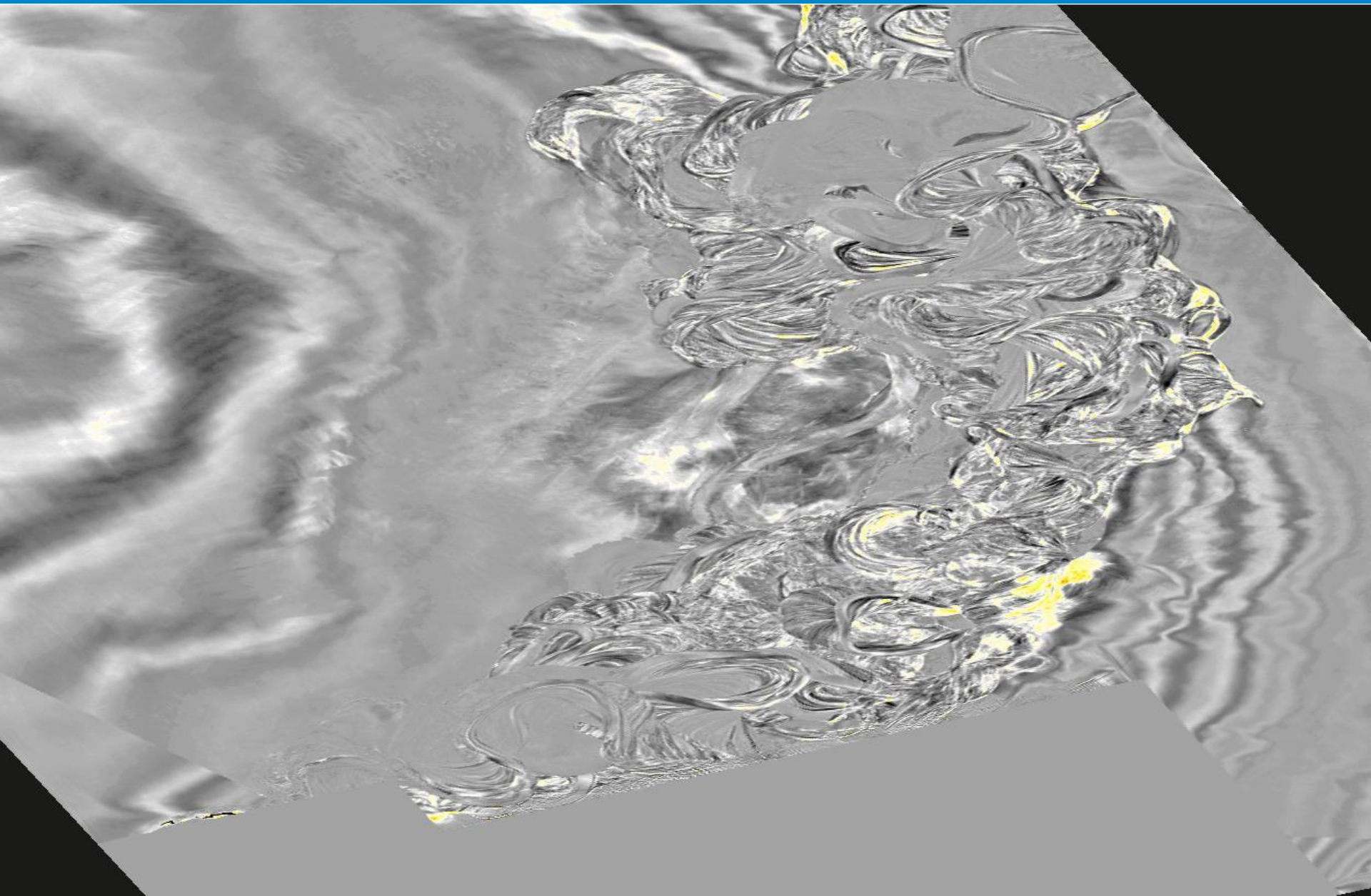
Flattened slice bottom of Channel-levee system



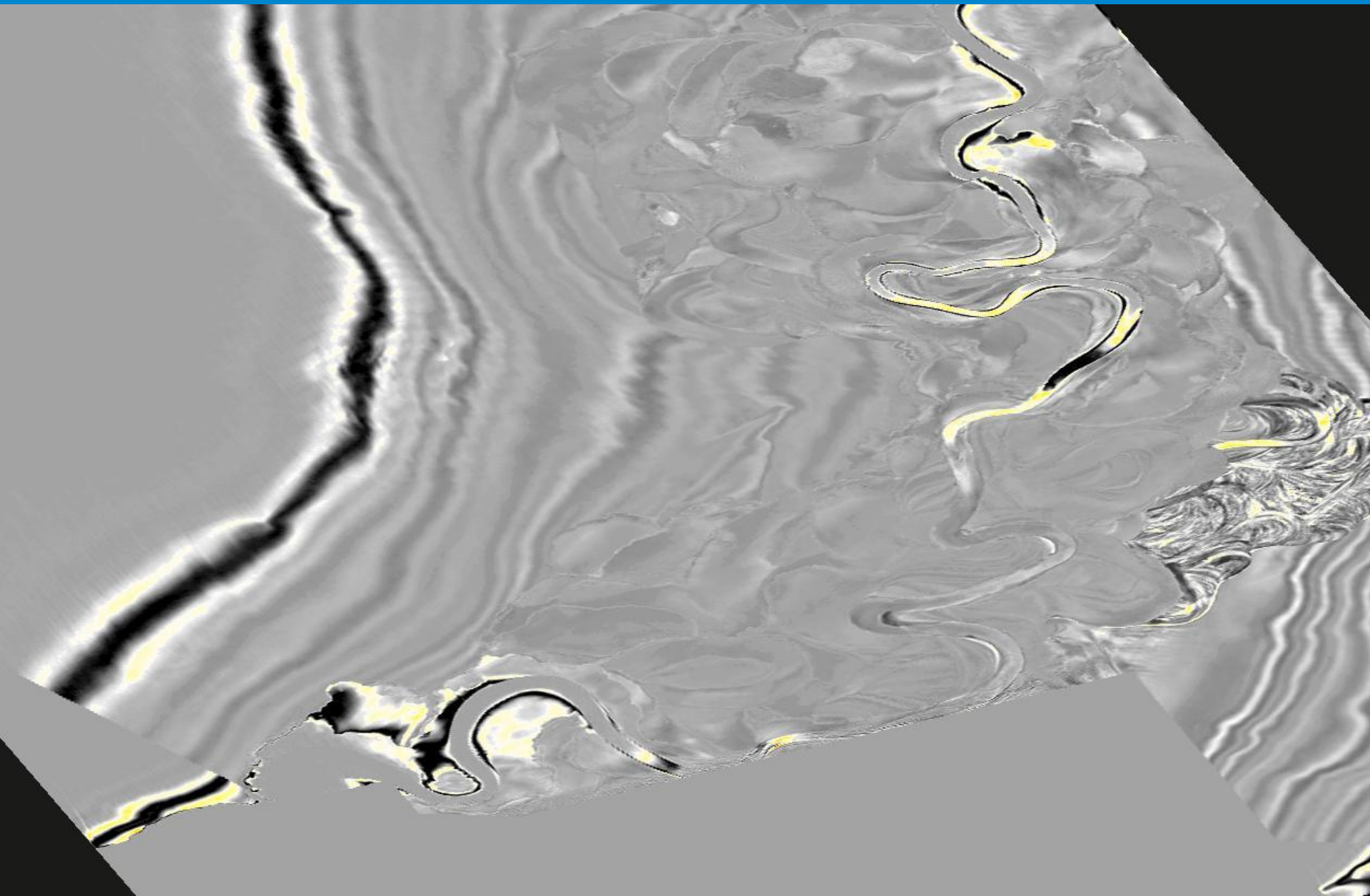
Flattened slice



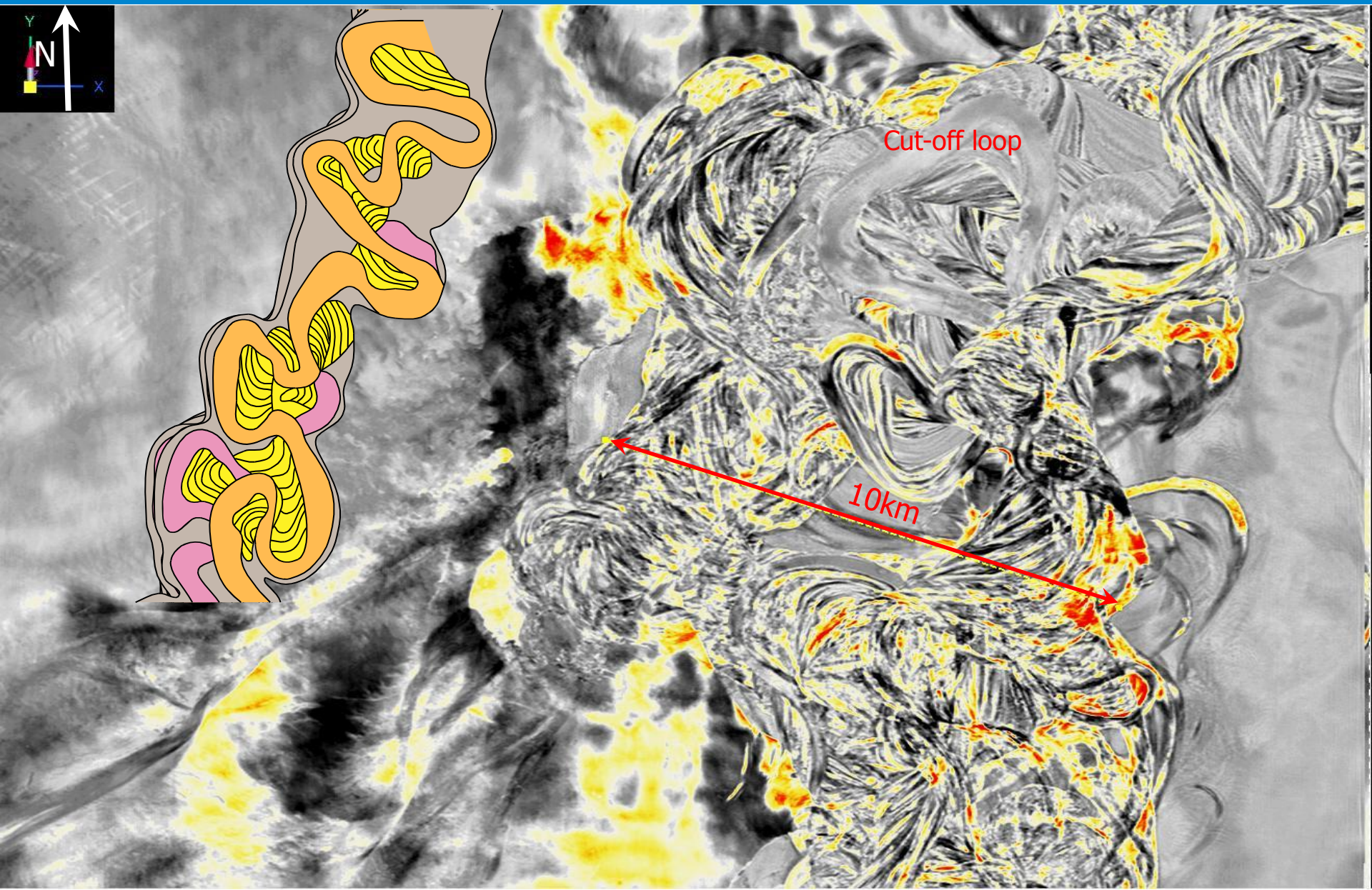
Flattened slice upper part of Channel-levee system



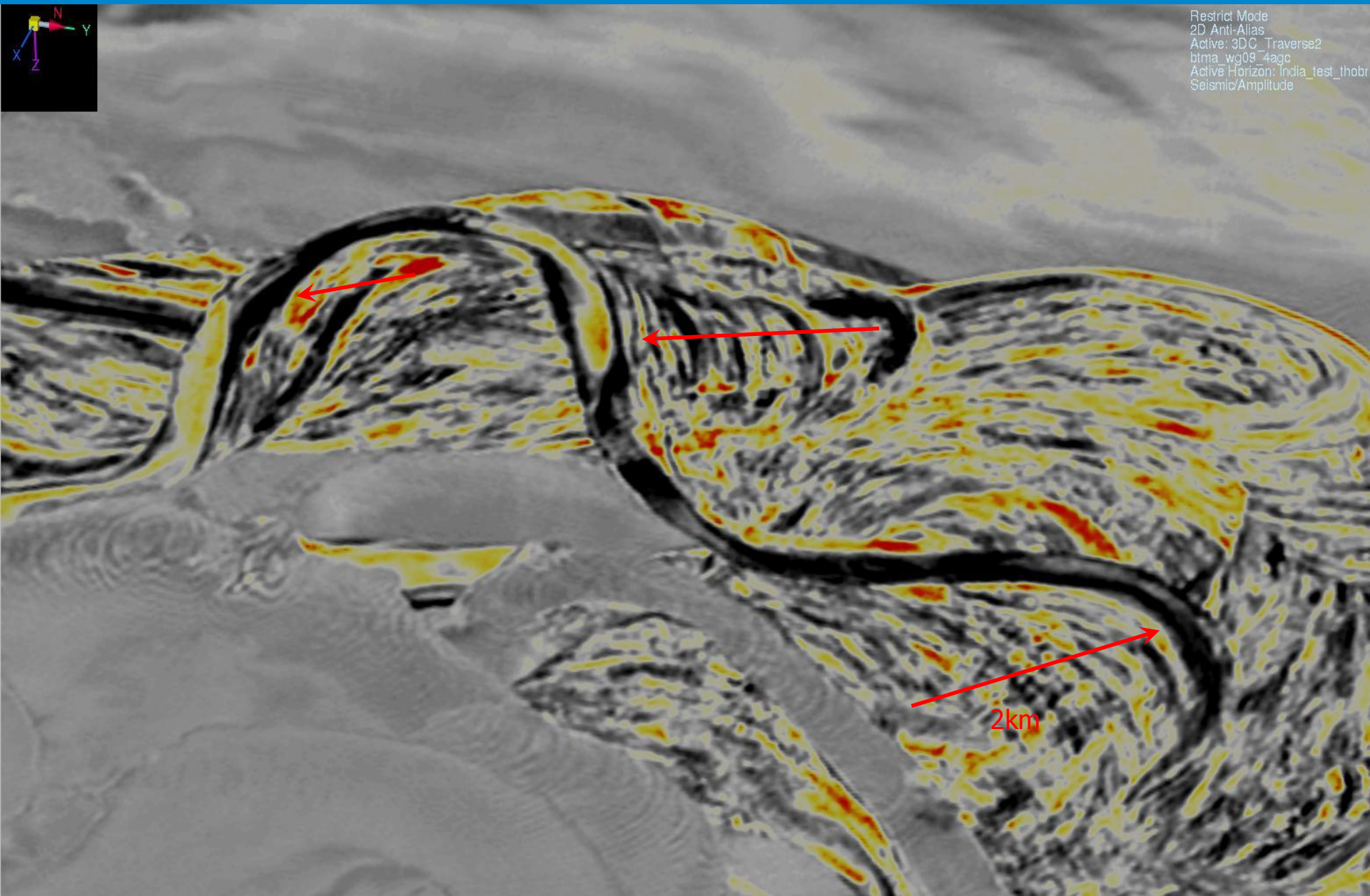
Flattened slice Current thalweg



Flattened slice : meandering channels



Channel migration and aggradation



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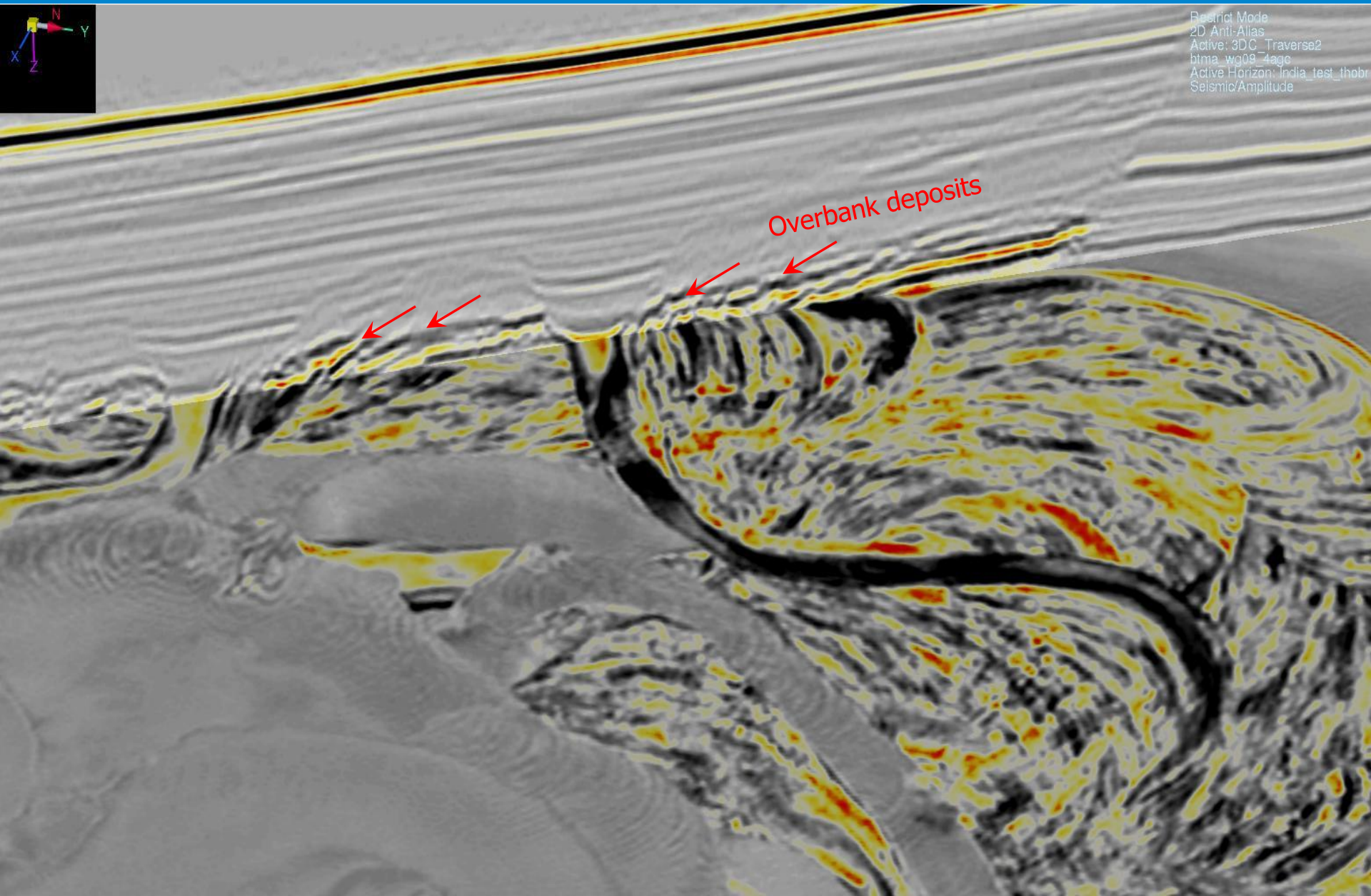

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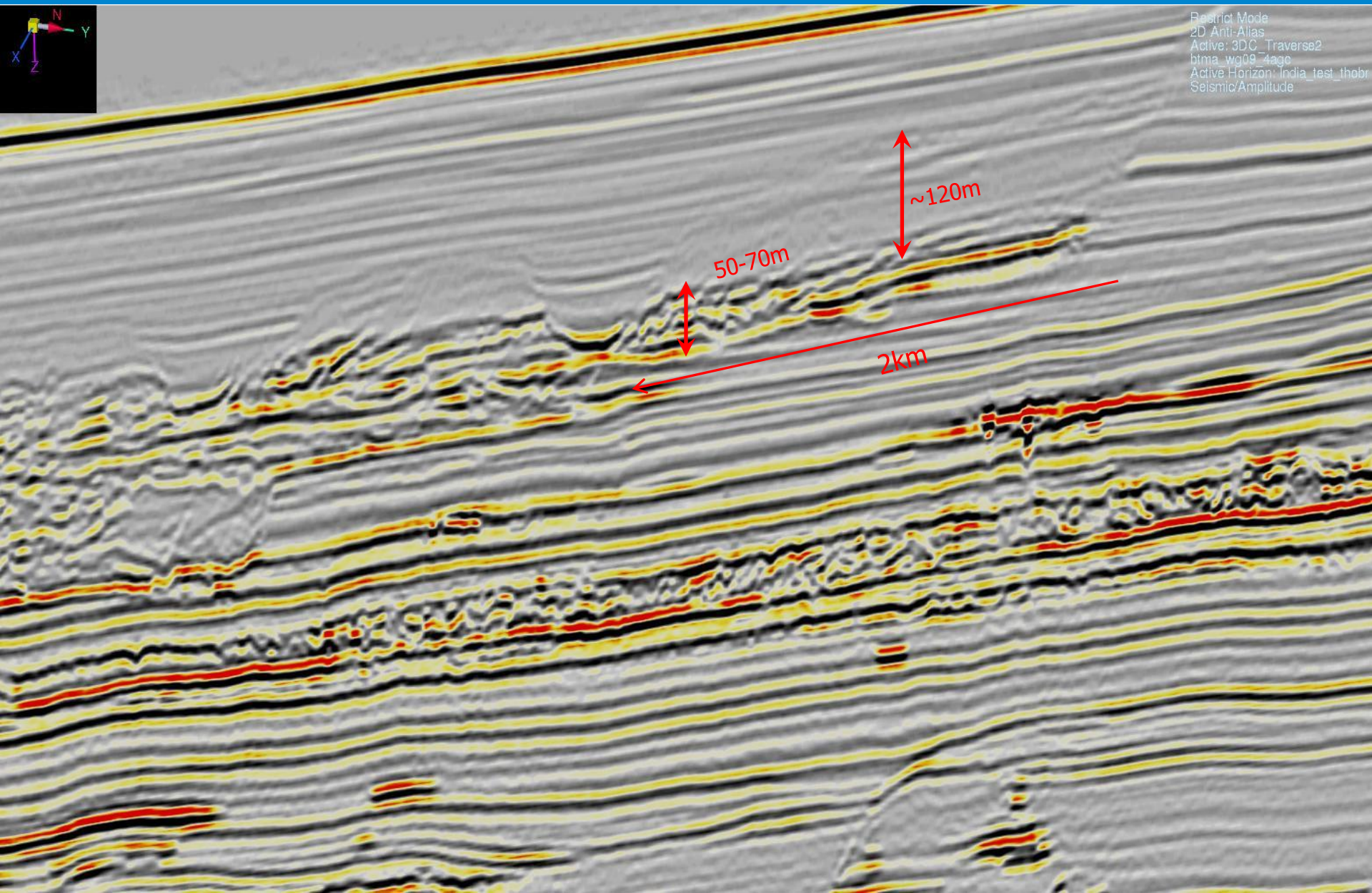
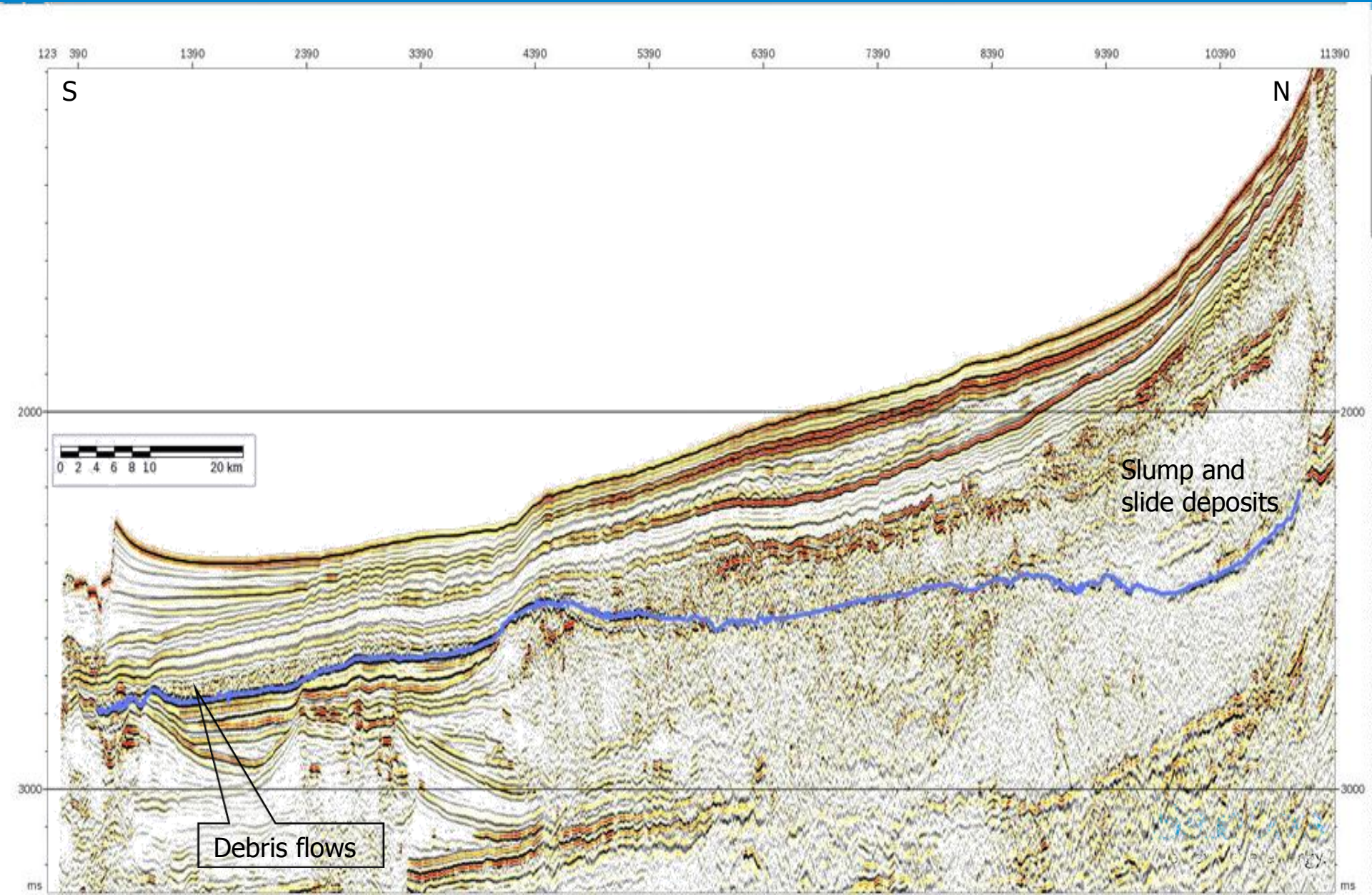
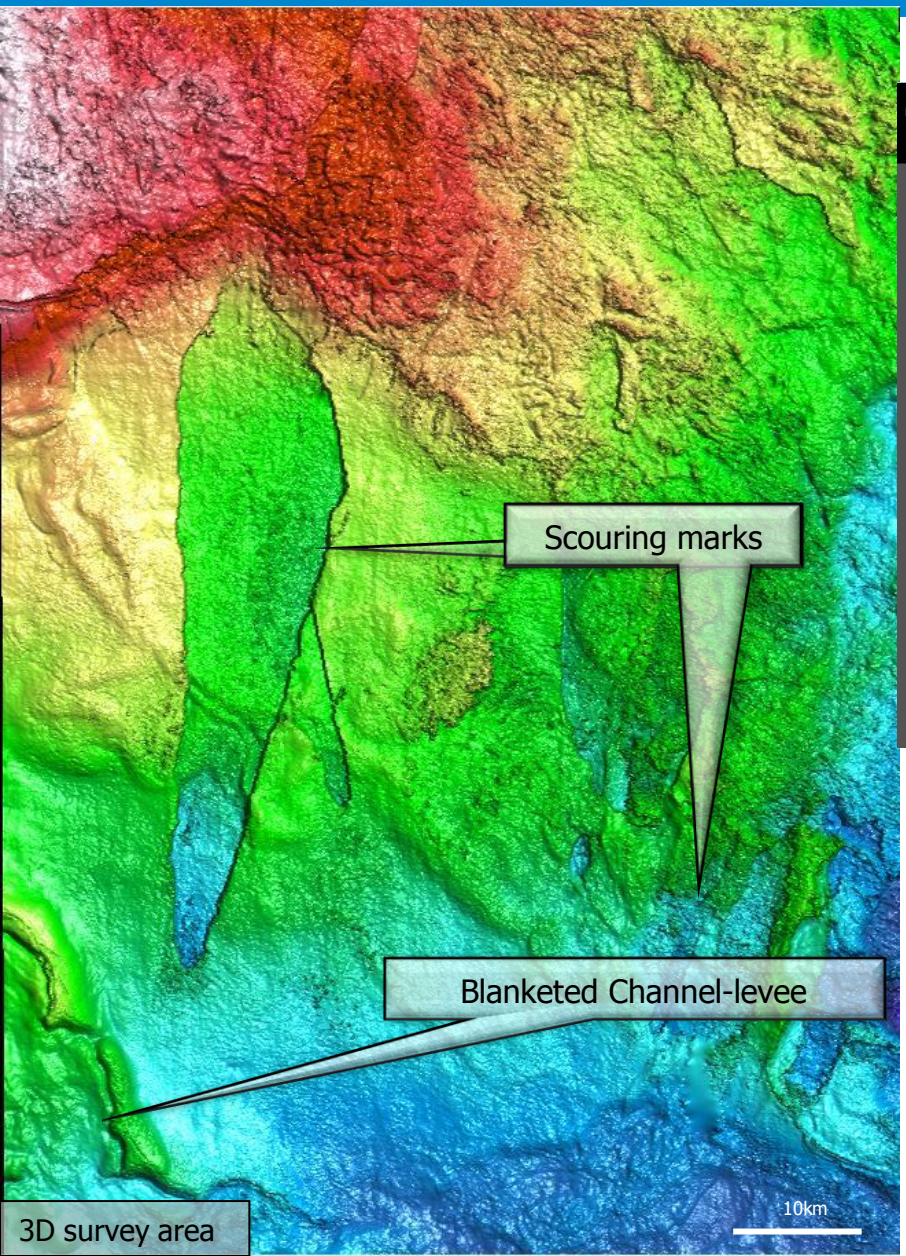
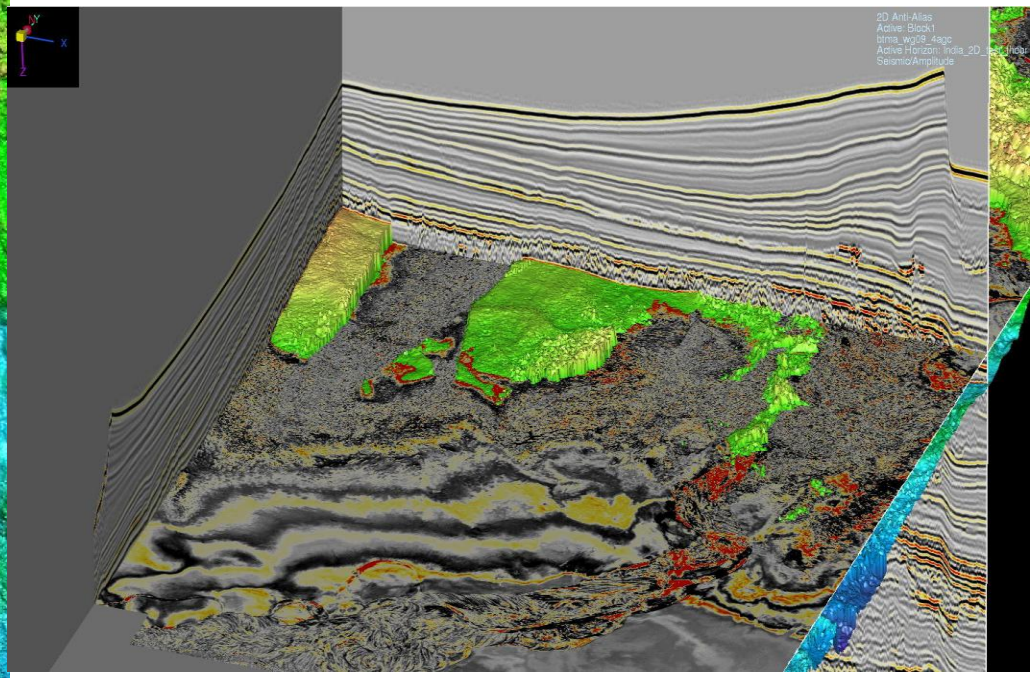


Slumps and mass transport deposits



Mass transport bottom surface





Mass transports re-mobilise sediments deposited on the upper slope over vast area of x10,000km^2

They can bury pre-existing channel-levee deposits and in place erode them

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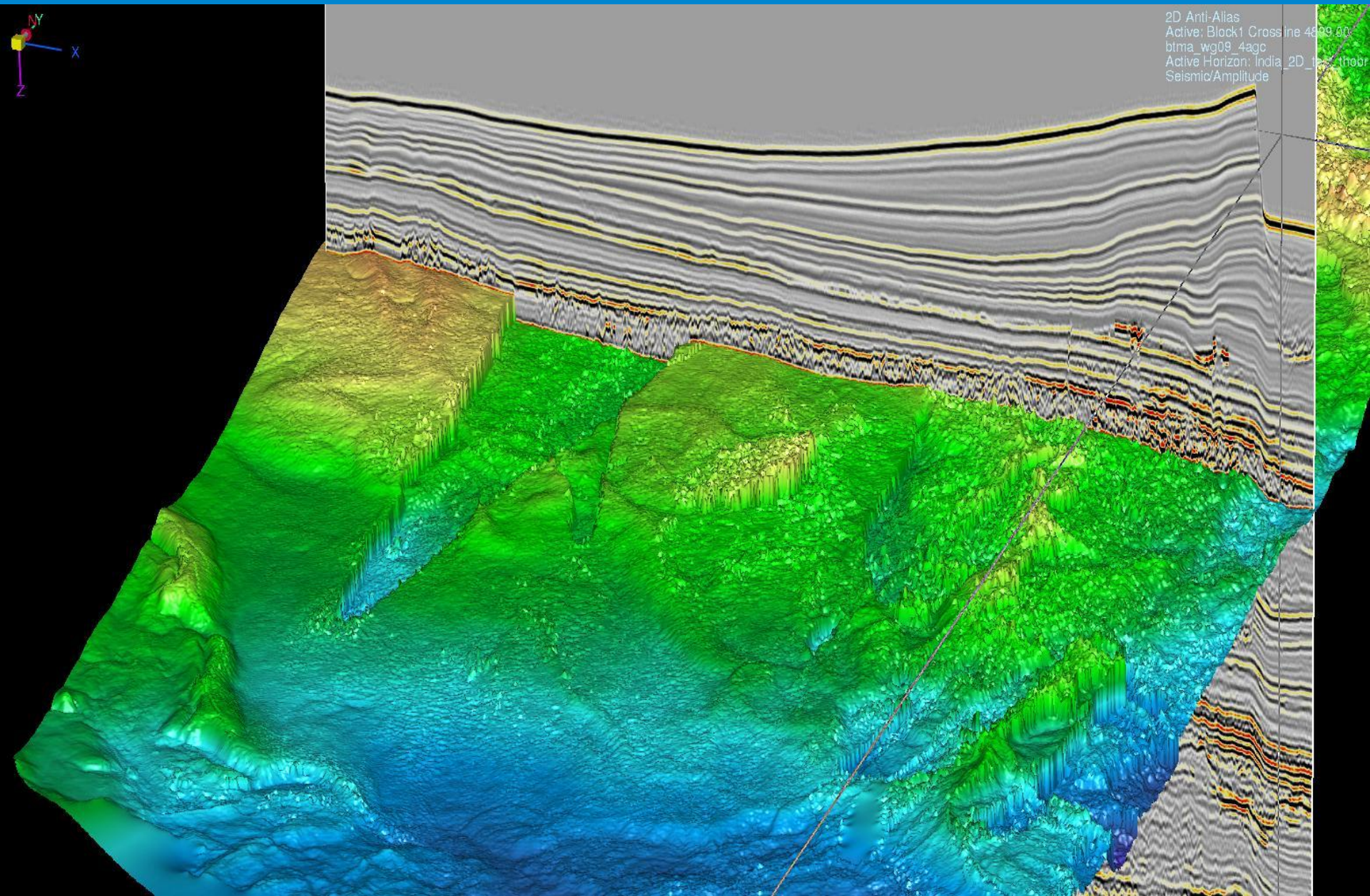
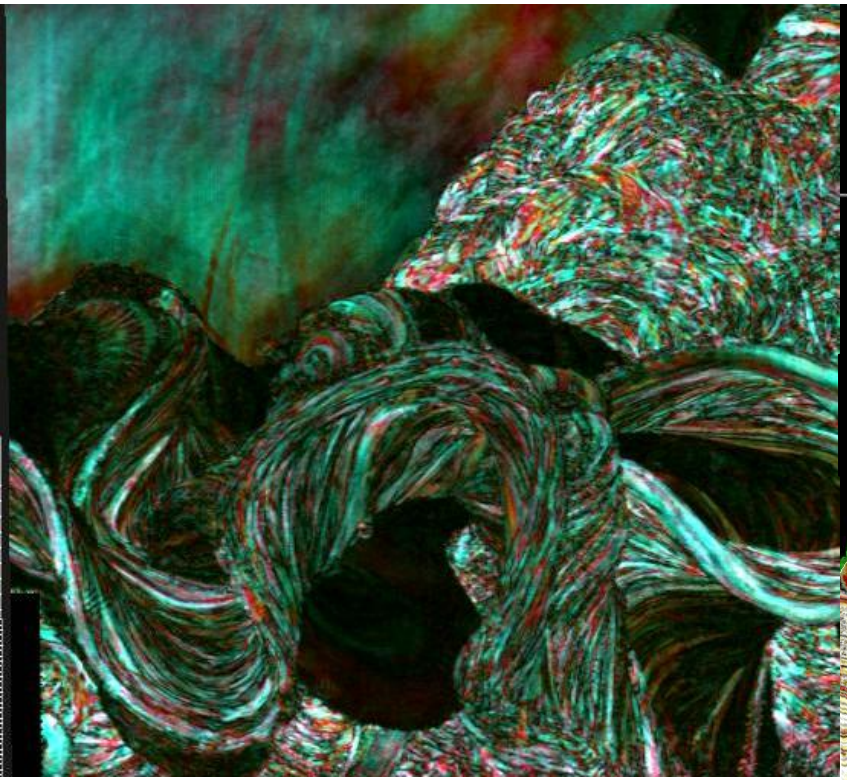
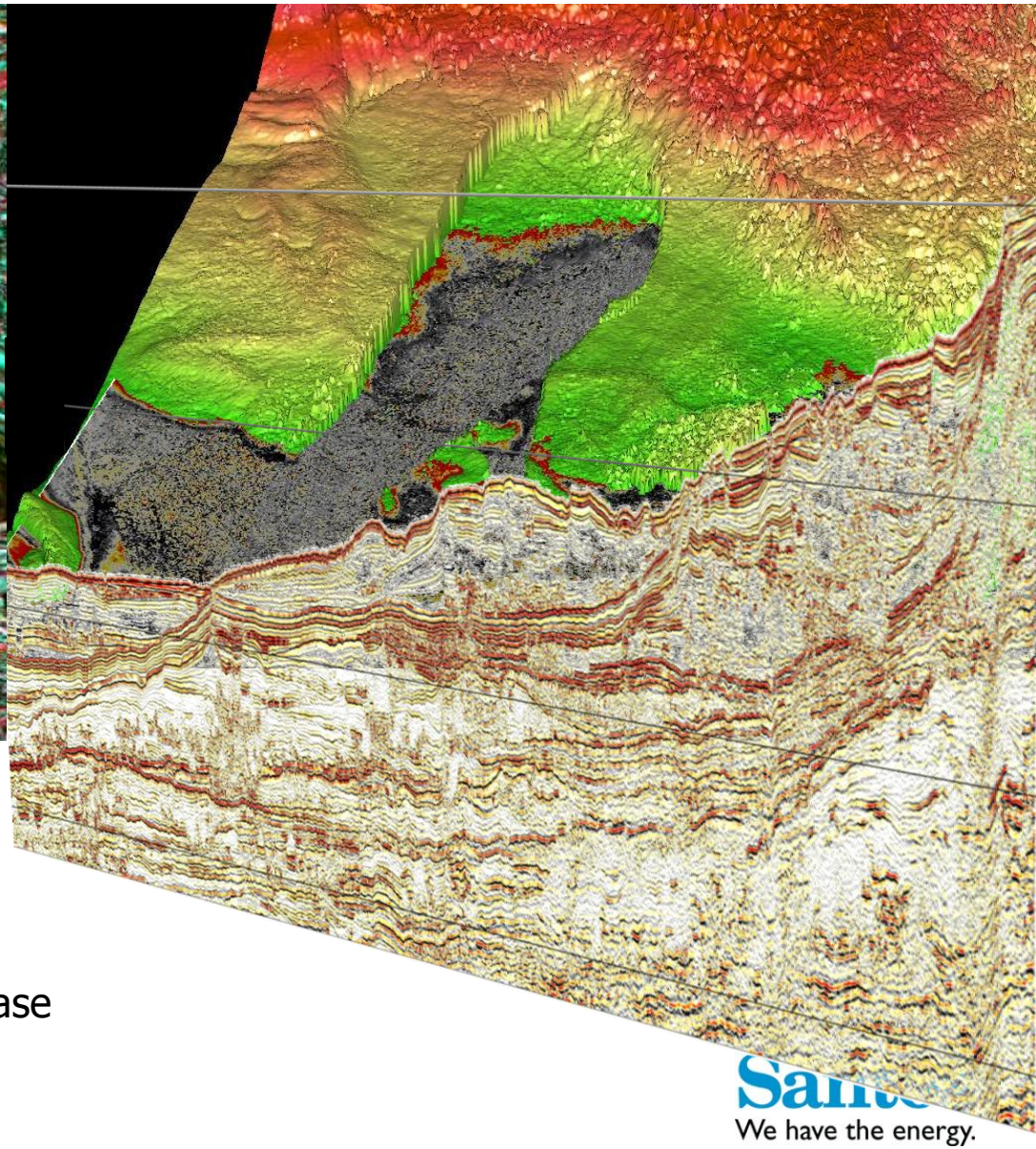
Mass transport deposit



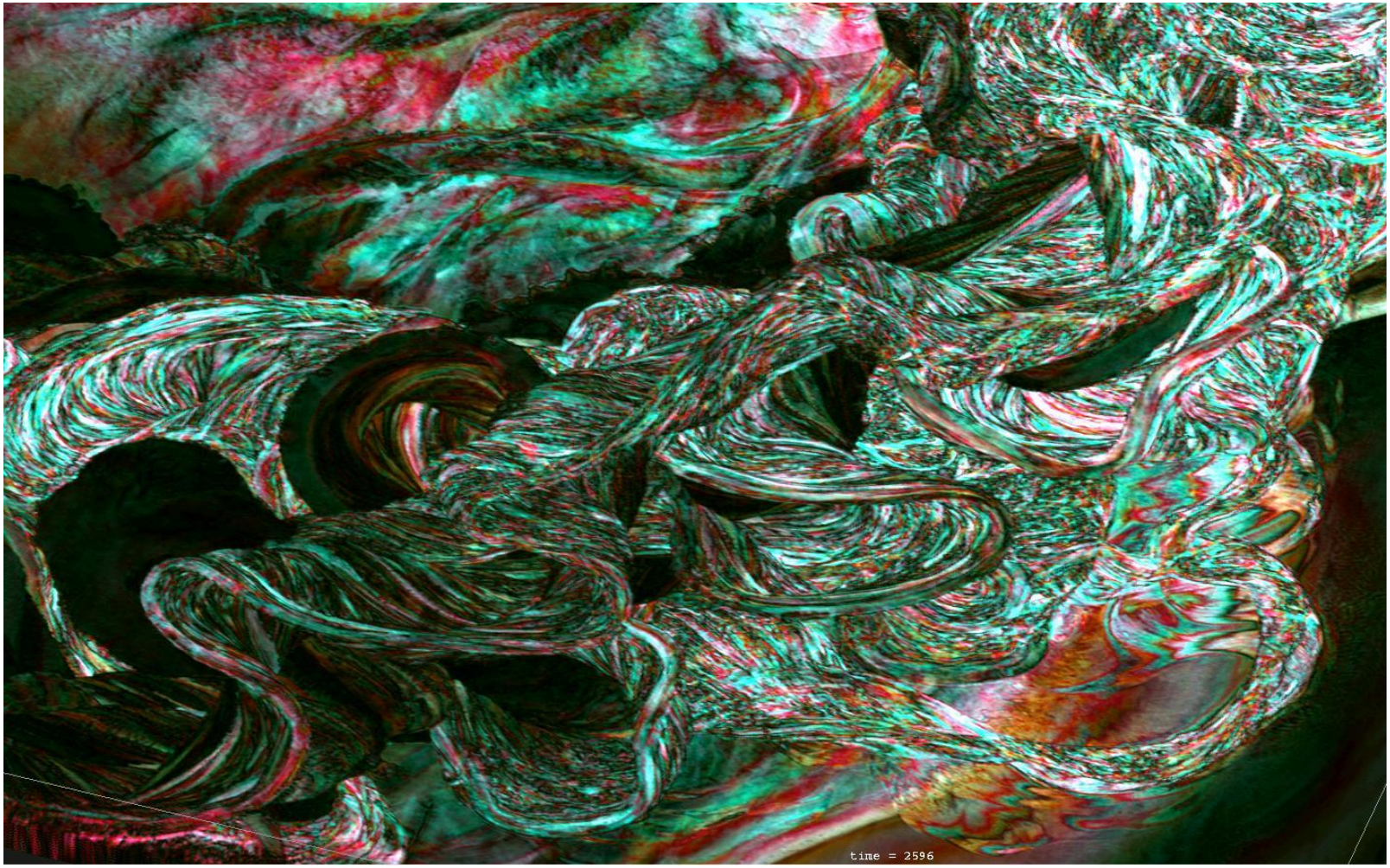
Conclusions





- Channel-levee complexes
  - Basal erosion
  - Channel aggradation
  - Levees build up
  - Abandonment and avulsion phase
- Mass transport deposits
  - Slumps and debris flows

Thank you



Acknowledgements:

DGH
DIRECTORATE GENERAL OF HYDROCARBONS
(Under Ministry of Petroleum & Natural Gas, Govt. of India)

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